Shasta River TMDL

Meeting of the Technical Advisory Group and Interested Pa

November 22, 2004

Purpose of Meeting

- **To update the group on the status of Shasta River TMDL development efforts**
- **To get your input**
- **To answer your questions**

Outline

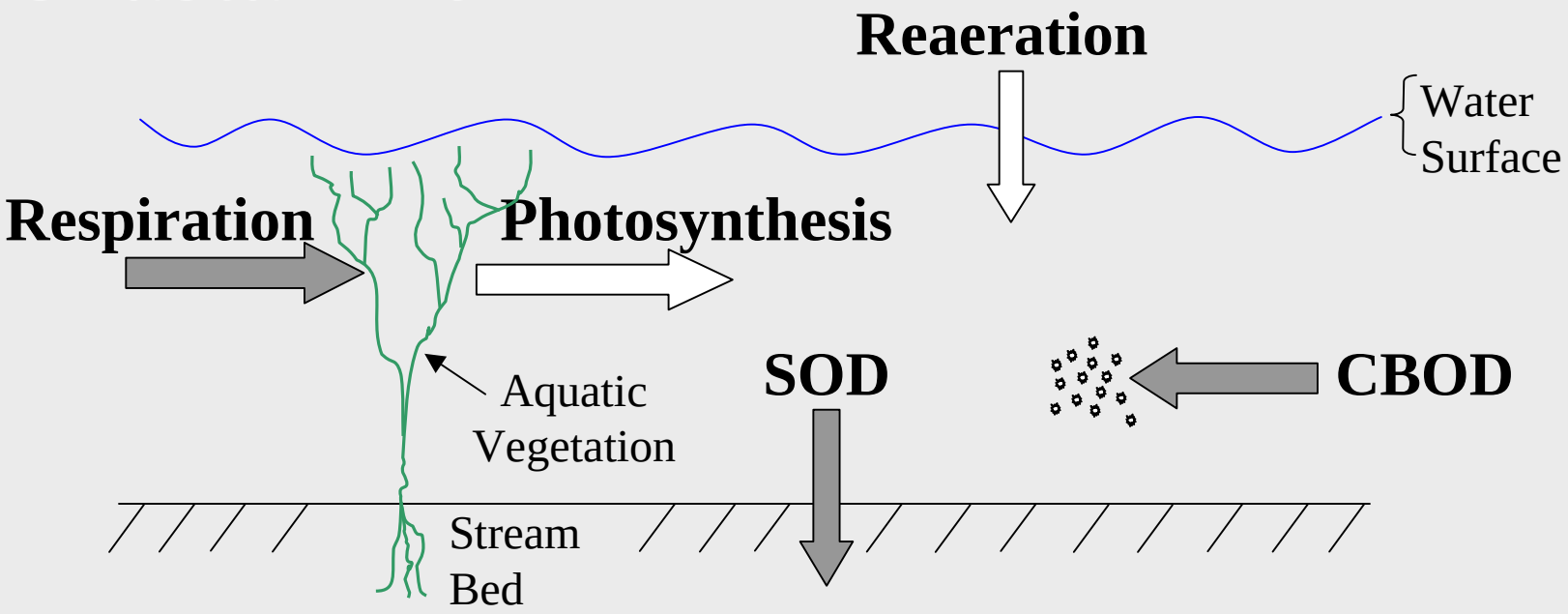
- Introductions
- TMDL schedule
- Dissolved oxygen conceptual model
- 2004 monitoring results
- Status of modeling and assessment tasks
- Feedback – Q &A

Introductions

TMDL Schedule

- Public review draft of technical TMDL – February 2005
- TMDL implementation plan development – Ongoing until December 2005
- Regional Water Board adoption of TMDL – December 2005
- EPA approval of TMDL – January 2007
- TMDL implementation – February 2007

Factors Affecting Dissolved Oxygen in the Shasta River



Dissolved Oxygen Sources

- Reaeration
- Photosynthesis

Dissolved Oxygen Sinks

- Respiration
- Sediment Oxygen Demand (SOD)
- Carbonaceous Deoxygenation (CBOD)

2004 Monitoring

- Aquatic vegetation surveys –

  Characterized spatial distribution, composition, and biomass of aquatic plants
- Stream sediment size characterization –

  Visual estimates of percent composition by particle size classes
- Riparian vegetation characterization –

  Visual estimates of riparian density classes

2004 Monitoring

- Light intensity measurements –

  LI-COR Radiation Sensor

- Water quality monitoring –

  1. Discrete and continuous (July 30 - August 5) measurement of temperature, dissolved oxygen, pH, and specific conductance

  2. Temperatures of tailwater return flows

  3. End of irrigation season nutrient grab sammples

  4. Stable isotopes of water and aquatic plants

Public review draft available

"Shasta River Water Quality Related Investigations - 2004"

Aquatic Veg Survey - Key Results

- Walked or floated 2/3 of river from Dwinnell Dam to mouth
- Rooted vascular plants (macrophytes) dominant plant community
- Identified 19 species of macrophytes Dominant macrophyte species:

  Potamogeton spp. & Elodea canadensis
- Range of cover: 0 – 90%
- Large variation in biomass

Potomogeton spp.

Potamogeton pectinatus

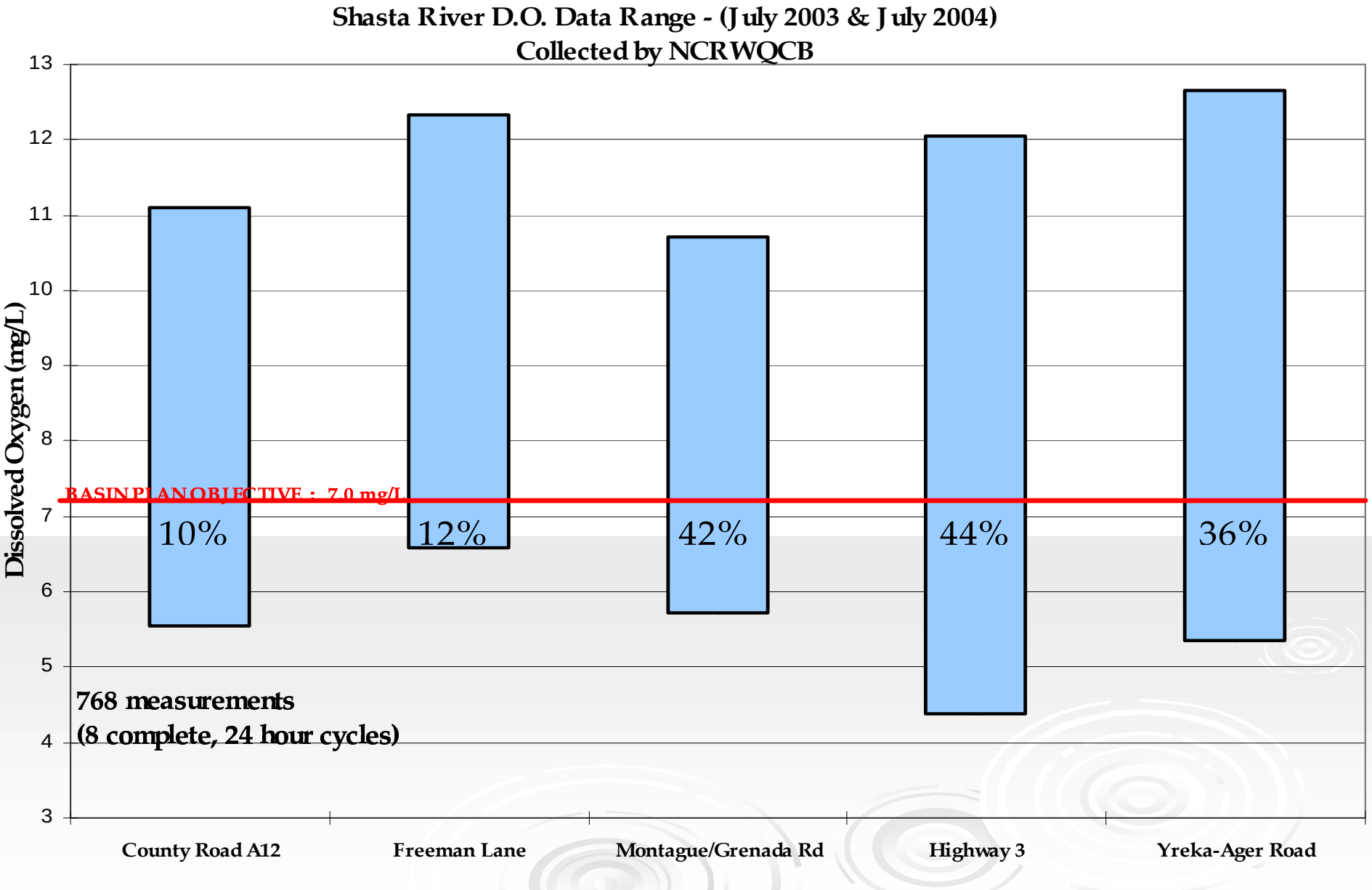
Elodea canadensis

Factors controlling macrophyte presence and biomass:

- Water velocity
- Stream gradient
- Light availability (riparian shade)
- Water depth
- Stream bottom sediment composition

Attached algae – key findings

- Identified 75 algae species
- Most species common to “productive” rivers
- Large variation in cover
- Moderate variation in biomass
- Factors controlling cover & biomass include:
  - Stream bottom sediment composition
  - Light availability
  - Water depth
  - Water velocity


Shasta River D.O. Data Range - (July 2003 & July 2004)
Collected by NCRWQCB
Dissolved Oxygen (mg/L)
13
12
11
10
9
8
7
6
5
4
3
BASIN PLAN OBJECTIVE : 7.0 mg/L
10%
12%
42%
44%
36%
768 measurements
(8 complete, 24 hour cycles)
County Road A12
Freeman Lane
Montague/Grenada Rd
Highway 3
Yreka-Ager Road

Modeling and Assessment Tasks

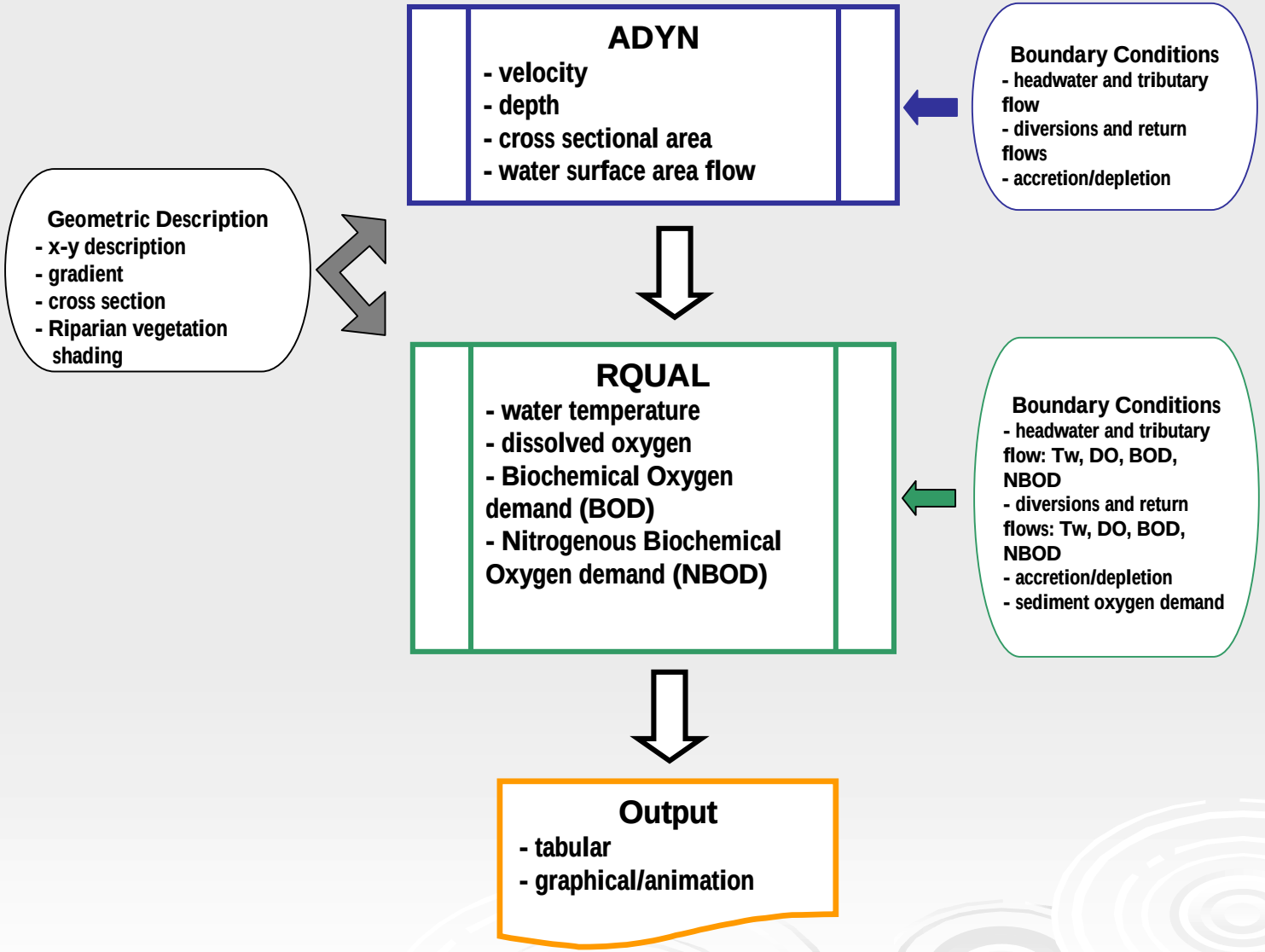
- Numerical Flow and Water Quality Modeling
- Primary Productions Limiting Factor Analysis
- Lake Shastina Limnological Assessment

Numerical Flow and Water Quality Analysis

- The Models
- Model Calibration
  - Review
  - Updates and modifications
- Model Application

The Models

- Tennessee Valley Authority (TVA): coupled hydrodynamics and water quality
- ADYN – flow (hydrodynamics)
  - St Venant Equation (full momentum representation)
- RQUAL – water quality
  - Advection (no diffusion) equation
- Finite difference models with variable Δx


ADYN
- velocity
- depth
- cross sectional area
- water surface area flow
Boundary Conditions
- headwater and tributary flow
- diversions and return flows
- accretion/depletion
Geometric Description
- x-y description
- gradient
- cross section
- Riparian vegetation shading
RQUAL
- water temperature
- dissolved oxygen
- Biochemical Oxygen demand (BOD)
- Nitrogenous Biochemical Oxygen demand (NBOD)
Boundary Conditions
- headwater and tributary flow: Tw, DO, BOD, NBOD
- diversions and return flows: Tw, DO, BOD, NBOD
- accretion/depletion
- sediment oxygen demand
Output
- tabular
- graphical/animation

Model Objective

- Represent
  - Water temperature
  - Dissolved oxygen dynamics
- In response to…
  - BOD
  - NBOD
  - Benthic algae and macrophytes
  - Sediment oxygen demand (SOD)
  - Riparian shading
  - Boundary conditions (alternatives)

Model Calibration

- Previous work
- Model modifications
- Calibration status

Previous Work

- U.C. Davis (1997): different modeling framework
- Extended previous TVA modeling work (Alida Abbott, 2002): cooperative effort sponsored by Shasta Valley RCD with funding from CDFG and USFWS (Task Force)

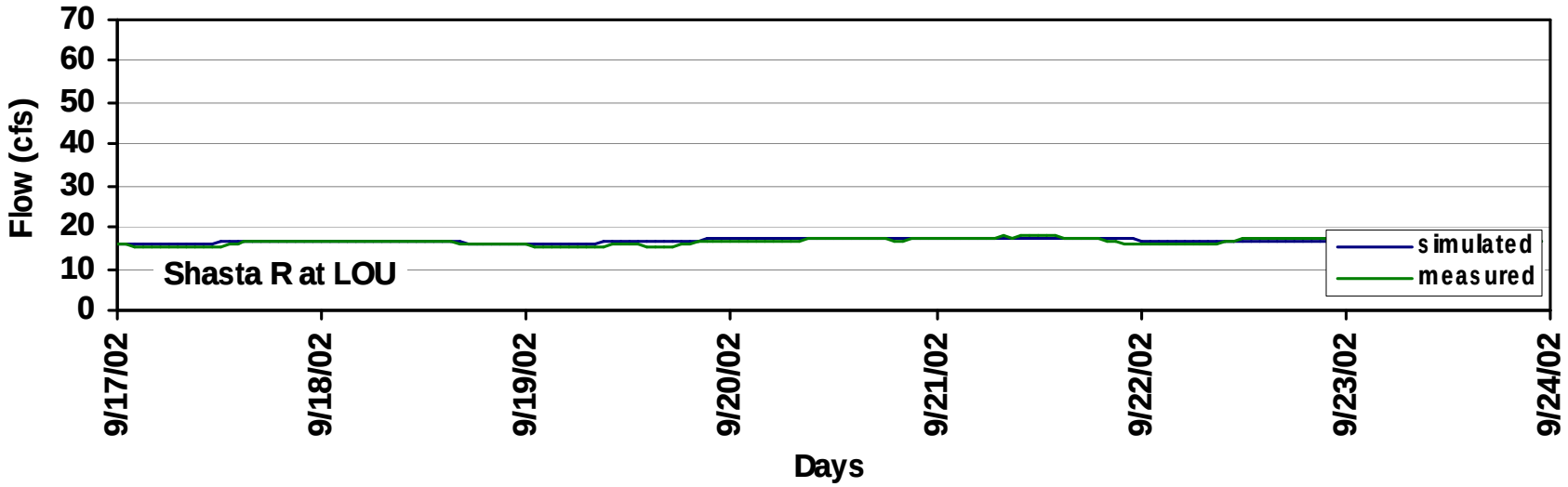
Model Modifications

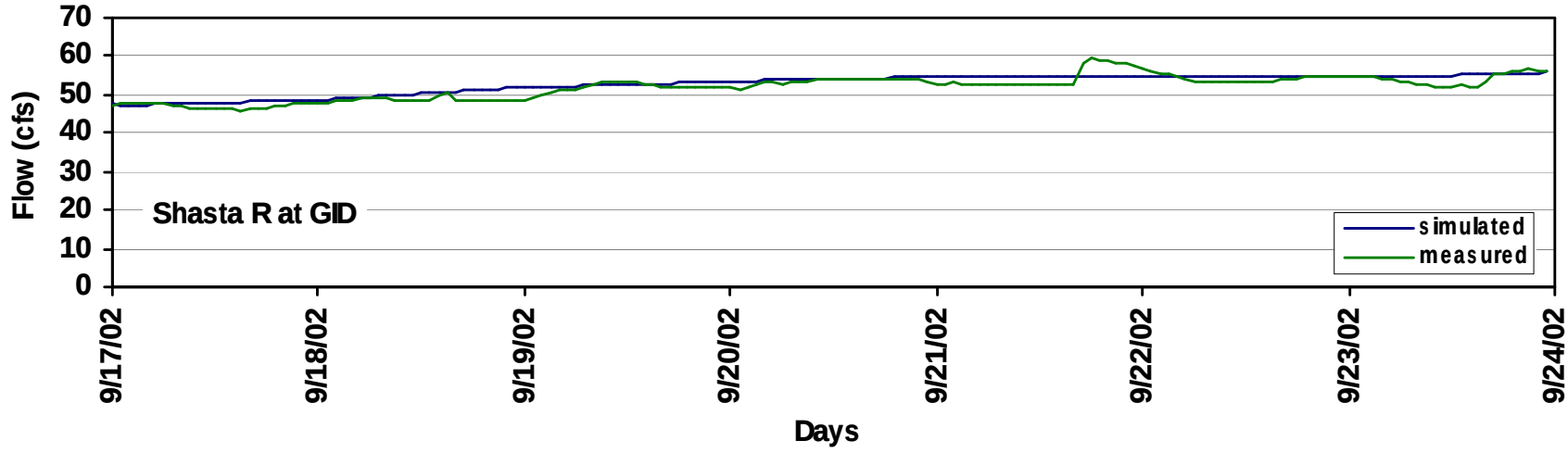
- Extended to Dwinnell Dam
- Updated boundary conditions with 2002 and 2003 data
- Re-assessed shading characteristics
- Implemented latest UTM river description

Calibration Status

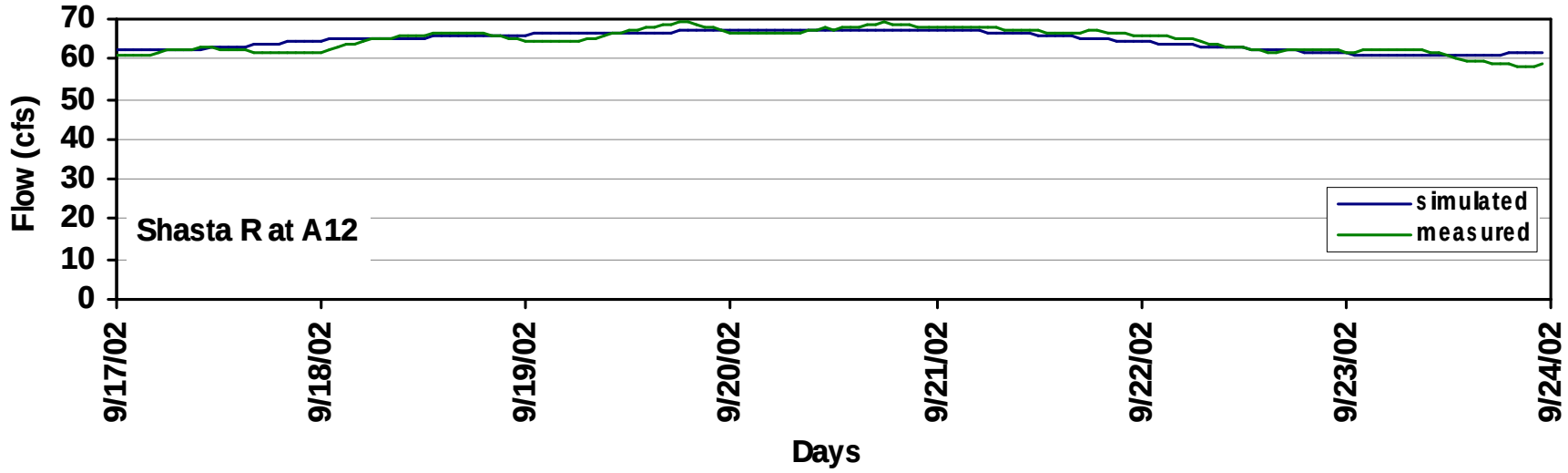
- Flow: complete
- Temperature: complete
- Dissolved oxygen: preliminary
- BOD: preliminary

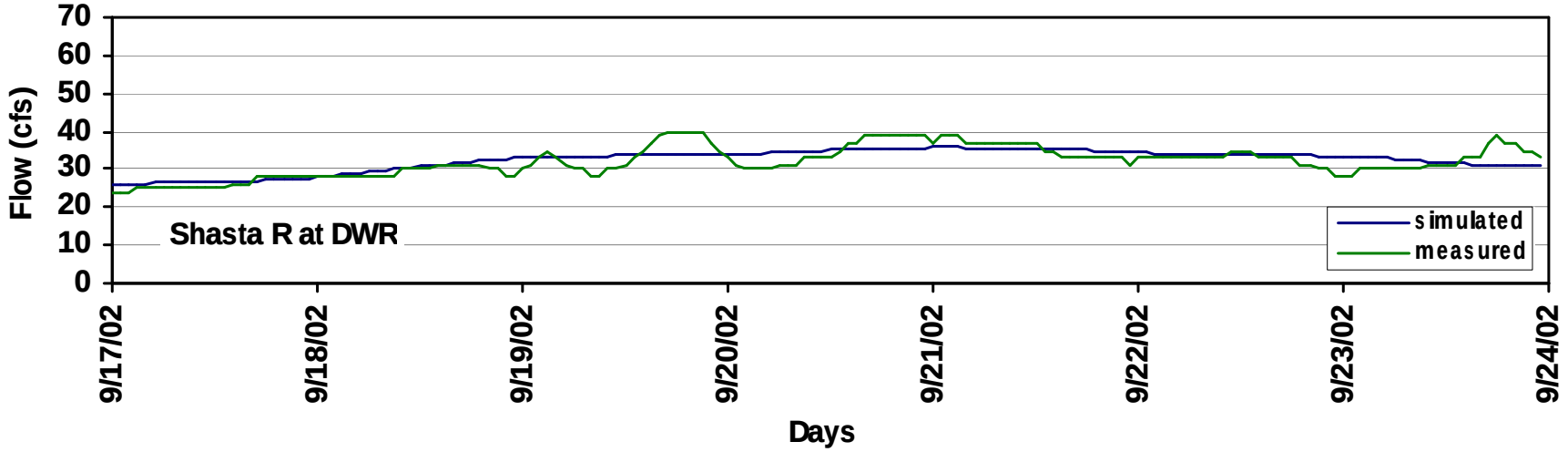
Calibration: Flow





Calibration: Flow





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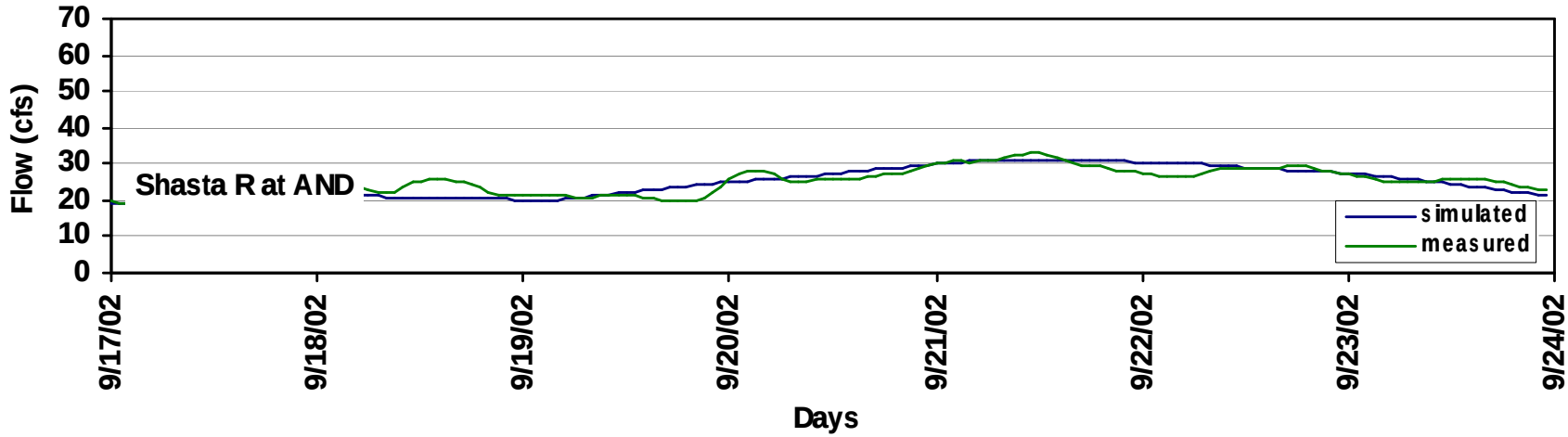
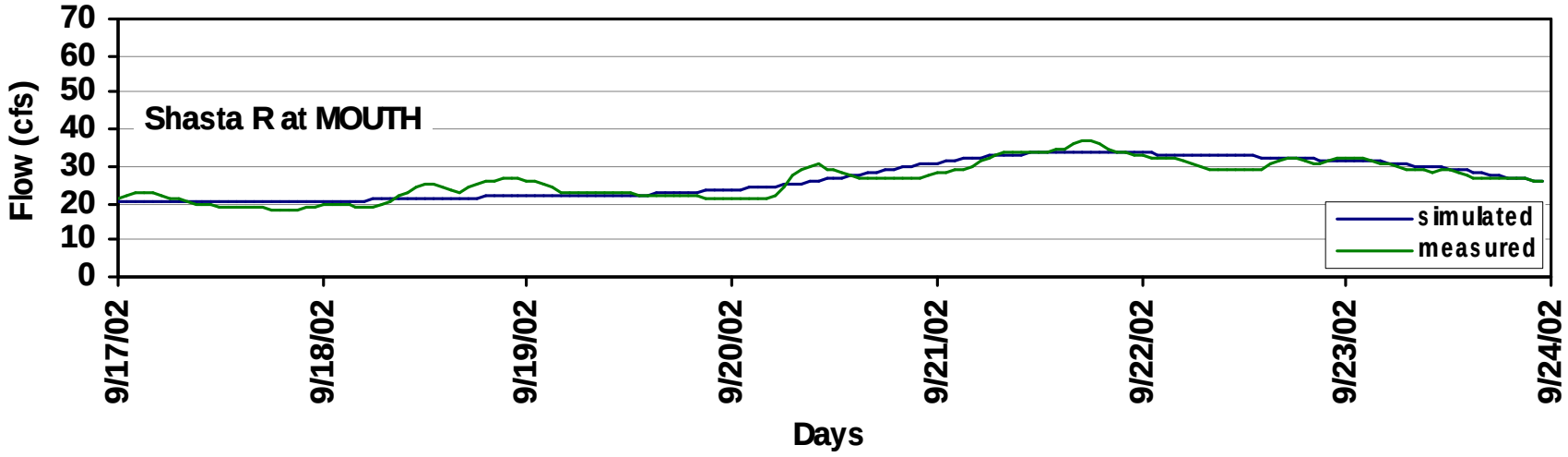
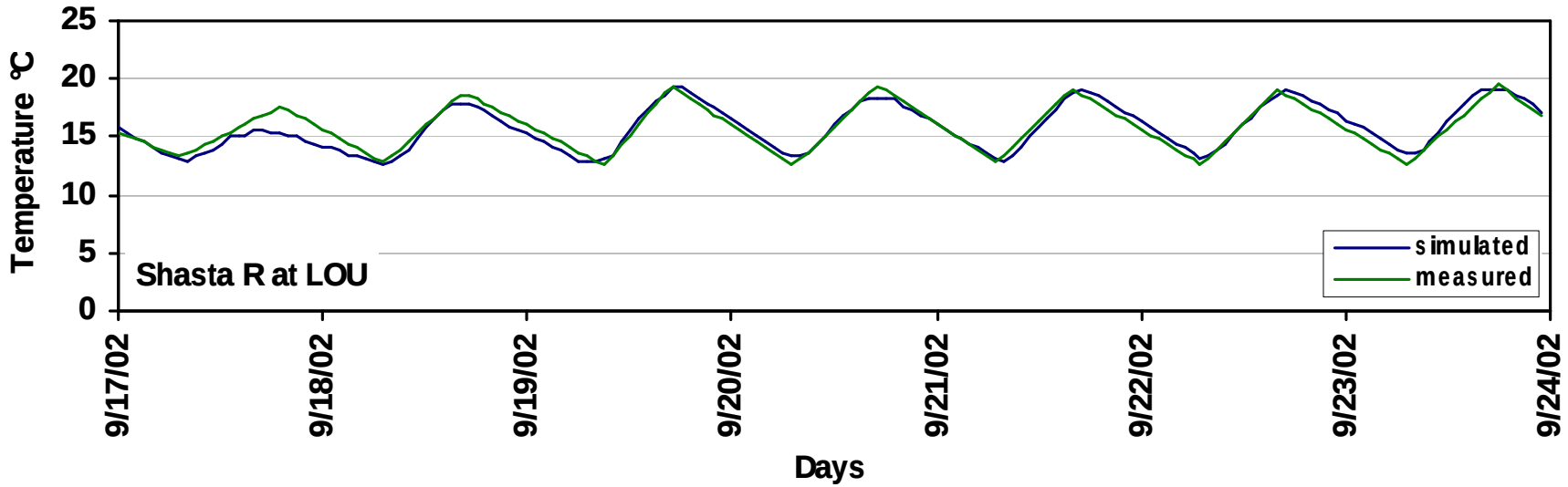
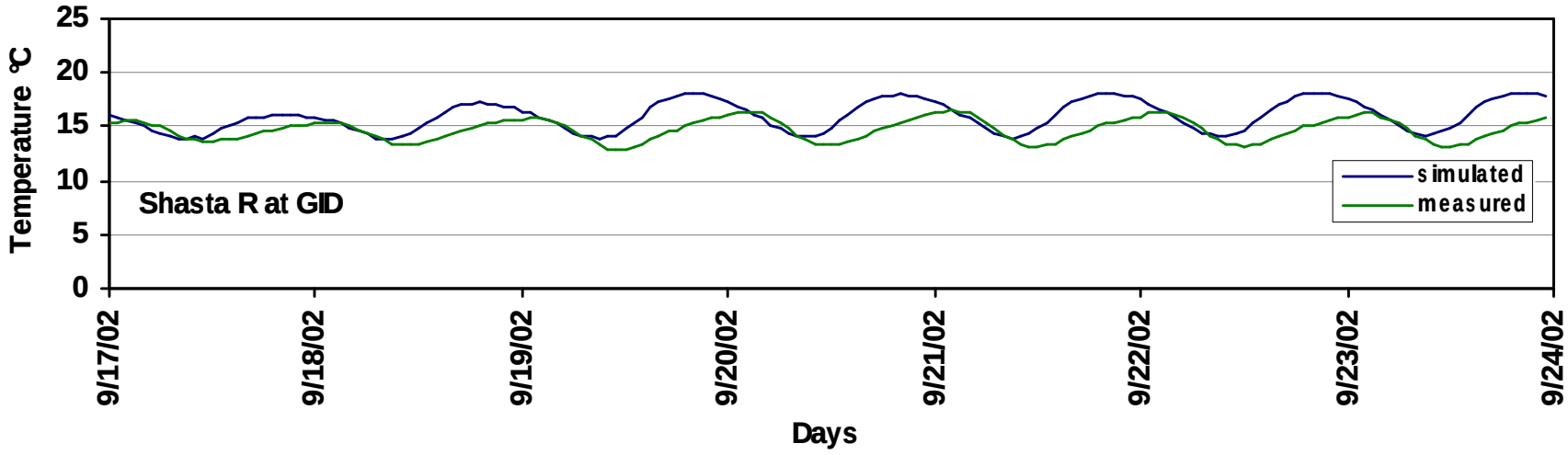




Calibration: Temperature





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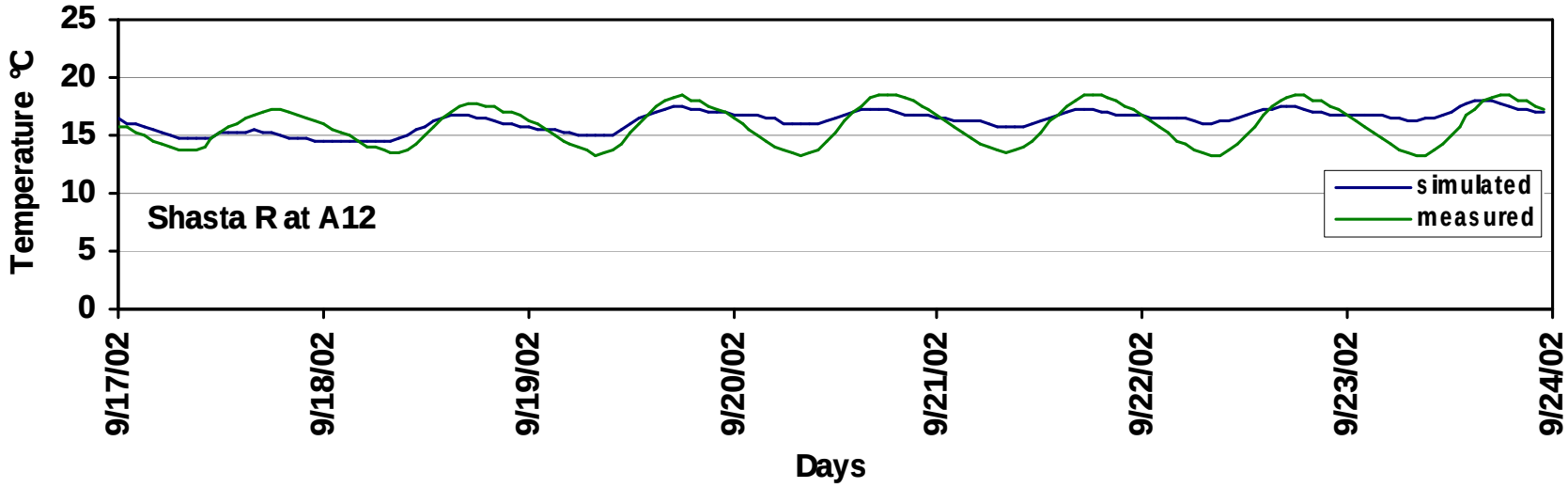
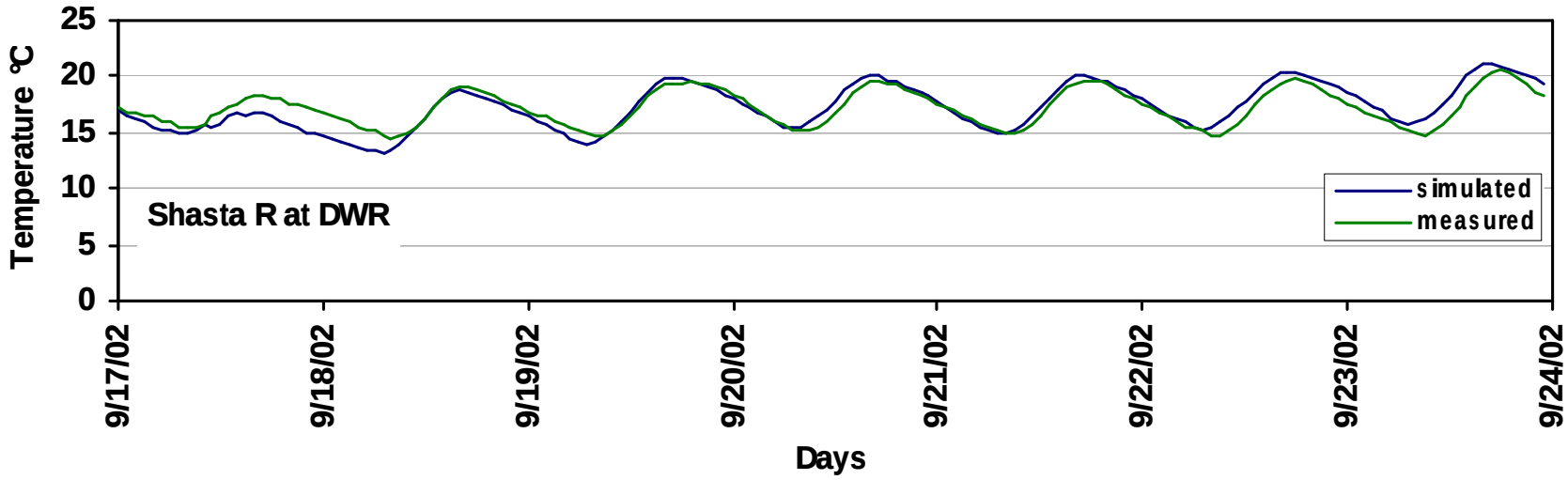
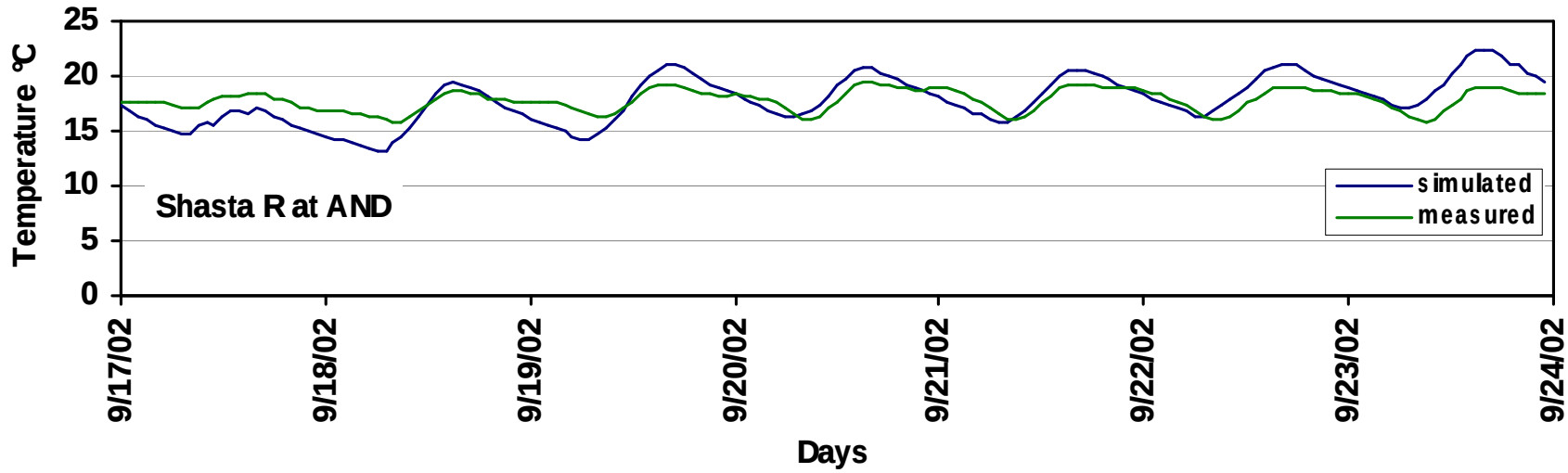
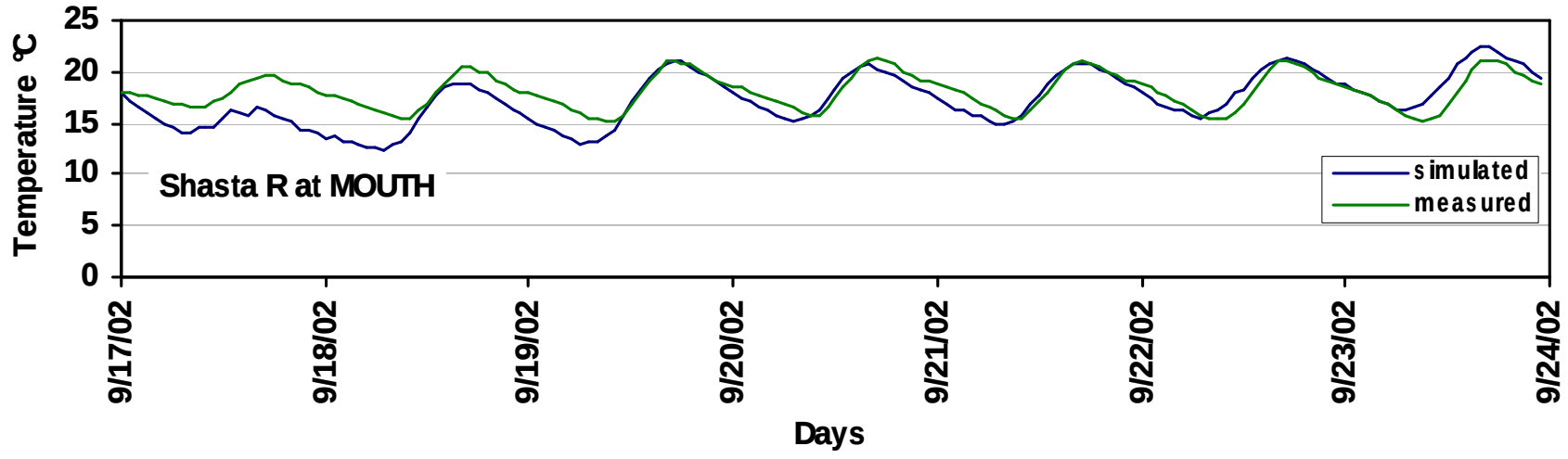




Calibration: Temperature





Primary Productions Limiting Factor Analysis

- Nutrients

  → Primary Production (macrophytes)

  → Dissolved Oxygen

- Primary Production: function of…
  - Nutrients
  - Light
  - Substrate (presumed widely available)

Lake Shastina Limnological Assessment

- Literature review
- Data assessment
- Document current status and conditions

Questions/Comments?